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REVIEW ARTICLE

CURRENT CONCEPTS

How Can We Prevent Lyme Disease?

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Area-wide acaricides

- Chemicals like carbaryl, cyfluthrin, fulvalinate, permethrin, deltamethrin etc. can give 68-100% control of nymphal *I. scapularis*, BUT
- Surveys in CT, MA, NJ, NY show most homeowners not willing to use them
- Need other options to offer

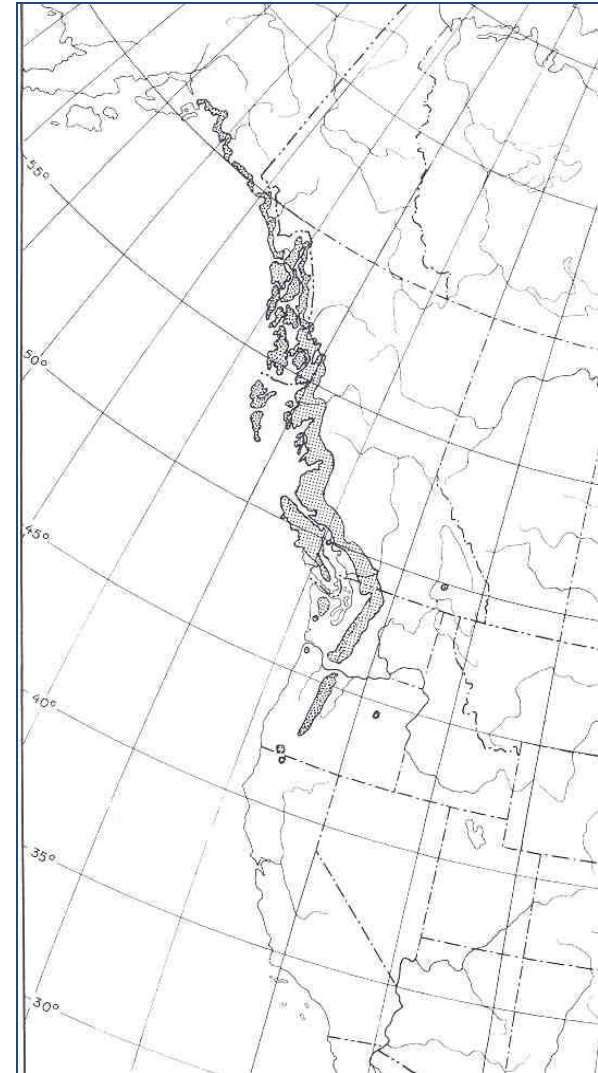
Prevention Measures Taken

• Long pants	49.8%
• Cleared Brush	48.6%
• Tick checks	45.7%
• Avoid woods	35.1%
• Pesticide on ground	24.4%
• Fenced property	23.1%
• Tucked pants/sock	18.3%
• Repellents/clothes	14.2%
• Used woodchip/gravel barrier	11.4%
• Vaccine	10.1%
• Pesticide on Rodents	9.0%

ALTERNATIVES TO AREA-WIDE ACARICIDES

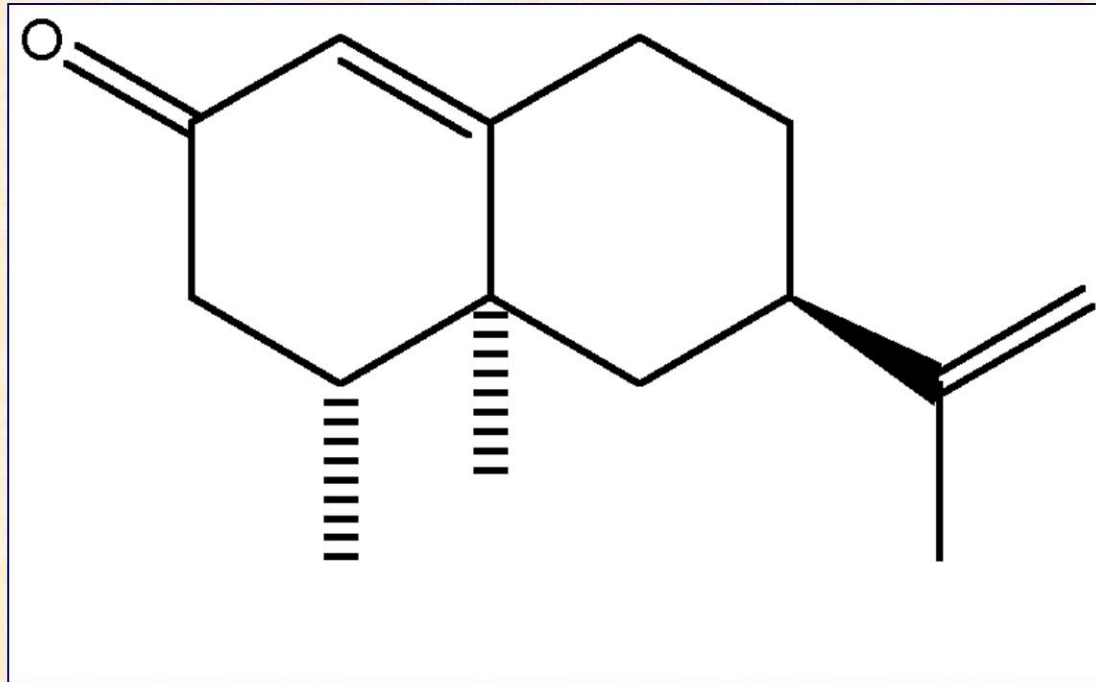
- Host Removal
- Host Targeted Treatments (Deer & Rodents)
- Least Toxic (Soaps, Desiccants, **Tree Extracts**)
- Fungal Agents
- Landscape Management

Insecticidal Constituents from Alaska Yellow Cedar (*Chamaecyparis nootkatensis*)





Natural Products with Biocidal Activity Against Arthropods



Nootkatone :
Alaska Cedar, Grapefruit

Formulation of nootkatone for field trials

- Active Ingredient
 - Nootkatone 152 g
- Solvent
 - d-limonene 75g
- Emulsifier
 - EZ-Mulse 75g
- Delivery Rate
 - $\text{g/m}^2 \text{ a.i.} = 0.76$ $\% \text{ a.i.} = 2\%$



Field Trial: NWS Earle, NJ

No. nymphal *I. scapularis*

Days	Control	Backpack	Highpressure
PreTreatment	9.4	7.8	10.8
1	14.2	0 (100%)*	0 (100%)
7	21.6	3.2 (82%)	0.4 (98%)
14	20.2	2.6 (84%)	0.4 (98%)
21	14.8	5.8 (53%)	0 (100%)
28	14.8	4.8 (61%)	0 (100%)
35	9.4	4.6 (41%)	0.2 (98%)
42	6.4	1.2 (77%)	0 (100%)

*% control of nymphs based on Henderson's equation; 5 grids for each treatment

Summary of results

- Natural products such as nootkatone may have a role to play in controlling the vectors of Lyme disease spirochetes
- Backpack spray application kills and/or repels ticks that are at the surface of the leaf litter but ticks deeper in the leaf litter column are not killed and begin questing after 1-2 wks
- High pressure spray kills virtually all the nymphs on forest plots and provides protection for entire nymphal questing season

Multiple applications of nootkatone with backpack

Date post treatment	Untreated	Treated	(% Control)
Pretreatment	15.8*	12.3	NA
1d	14.2	0	(100%)
7d	17.0	1.2	(91%)
14d**	14.8	2.2	(81%)
21d	16.8	0	(100%)
28d	18.8	0.4	(97%)
35d	12.8	0.4	(96%)
42d	7.4	0.2	(96%)

*Mean # ticks on 5 plots; **reapplication after 2 weeks

ITM Study in NJ:

1. Deltamethrin barrier spray
2. 4-poster acaricides applied to deer
3. Bait box acaricides applied to rodents

VECTOR CONTROL, PEST MANAGEMENT, RESISTANCE, REPELLENTS

Integrated Use of 4-Poster Passive Topical Treatment Devices for Deer, Targeted Acaricide Applications, and Maxforce TMS Bait Boxes to Rapidly Suppress Populations of *Ixodes scapularis* (Acari: Ixodidae) in a Residential Landscape

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Study area in Millstone, NJ



Fig. 1. Aerial photograph of the Millstone Township, NJ, study area showing locations of the three bait box deployment sites, locations of the 4-Poster devices, and the untreated control areas.

Timeline of ITM Study in NJ

Method	Time period	# houses
4-poster (deer)	Fall 2003 to Spring 2006	38
Bait boxes (rodents)	Summer 2004 & 2005	13
Barrier spray	May 2004	13

USDA “4-POSTER” DEVICE



CORN BAITED SELF-APPLICATION WITH AMITRAZ



Control of Nymphal Ticks

	Preintvnt 2003	2004	2005	2006
Control Area	1.7	2.0	3.4	10.1
Treatment area	4.1	2.0	1.1	1.4
% Control*	NA	58.5%	86.6%	94.3%

*Percentage of control calculated by Henderson's equation

ITM in NJ: Phase II

- Can we continue the level of control achieved with 3-pronged approach (barrier spray, 4-poster, bait boxes) with just one method (4-poster)?
- Continued 4-poster devices through spring 2007 (barrier spray just performed in 2004, and bait boxes 2004 & 2005)

ITM: Phase II

	Preintrvnt 2003	2004	2005	2006	2007
Control	1.7	2.0	3.4	10.1	5.3
Treatment	4.1	2.0	1.1	1.4	1.8
% Control	NA	58.5	86.6	94.3	85.9

Future of ITM

- Area-wide acaricides where permitted
- Host targeted acaricides (deer and rodents)
- Host targeted vaccines
- Natural products
- Biological control agents (fungal or other)
- Must be made practical & economical for wide acceptance